European Commission

Science for Environment Policy

Crop wild relatives 'critically under-represented' in gene banks

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Wild plants closely related to crops, or 'crop wild relatives', contain genes that could be useful for developing resilient crop varieties and are, therefore, important for food security. This global study quantified their conservation status and availability for breeding. The researchers found major gaps in gene-bank stocks, with over 70% of crop wild relative species identified as 'high priority' for conservation action. The researchers say systematic efforts are needed to protect crop wild relatives for future plant breeding, including both protection in gene banks and local conservation.

As dogs evolved from wolves, today's food crops evolved from wild plants called crop wild relatives (CWR). Humans have used CWRs as a source of genetic material to improve the yield and quality of crops. For example, wild rice is often grown alongside domesticated rice to promote natural breeding and improve yield.

In the face of challenges to global food security, including a growing population, scarcity of water and land, soil degradation and climate change, there is a pressing need to increase the productivity and resilience of current agricultural systems. CWRs — which are more genetically diverse than domesticated crops — could be key to this, as they can contain genes for useful traits, such as tolerance to heat and pest resistance.

The value of CWRs comes from their ability to adapt to their local environment. It should therefore be priority to protect them in the wild, through *in situ* (local) conservation, where they can continue to develop these useful adaptations. It is also important to tackle the forms of intensive agriculture that have placed stress on wild plants and promoted a level of genetic similarity among crops, which could prevent them from adapting to future environmental changes.

Alongside these actions, gene banks can also be useful. Storing CWR genetic resources in gene banks means they can be used for plant breeding, or to maintain genetic diversity, in the future. However, assessments suggest there are major gaps in gene banks' collections.

In order to quantify the conservation status and availability of CWR in gene banks, researchers performed a global analysis of the wild relatives of 81 crops. The crops were chosen because of their economic importance and relevance to food security, and included cereals, root and tubers (such as potatoes), oil crops, fruits, vegetables, forage crops (crops that are grown to be used as feed for livestock, such as grasses, legumes, maize and alfalfa) and spices.

The researchers modelled the geographic distributions of 1 076 taxa (groups, such as species and subspecies) of CWR. To estimate how well their potential genetic diversity is being conserved, they compared the potential geographic and ecological diversity of the CWR to that which is currently available and accessible through gene banks.

The results showed that the diversity of CWR is poorly represented in gene banks. Over 29% of CWR (313 taxa, associated with 63 crops) had no accessions (collections of plant material — in the form of seeds, plants or *in vitro* samples — from a particular location: the basic working unit of conservation in gene banks). A further 24% (257 taxa) had fewer than 10 accessions.

Continued on next page.

Source: Castañeda-Álvarez, N., Khoury, C., Achicanoy, H., Bernau, V., Dempewolf, H., Eastwood, R., Guarino, L., Harker, R., Jarvis, A., Maxted, N., Müller, J., Ramirez-Villegas, J., Sosa, C., Struik, P., Vincent, H. & Toll, J. (2016). Global conservation priorities for crop wild relatives. *Nature Plants*, 2(4): 16022. DOI: 10.1038/NPLANTS.2016.22.

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To show which CWR are most in need of conservation, the researchers gave each CWR a priority score based on its current representation in gene banks. Over 70% of taxa were identified as 'high priority', indicating, the researchers say, that samples should be collected urgently to improve their representation in gene banks.

An analysis of CWR grouped by their corresponding crop showed that 72% of crops were also high priority, including economically important crops such as sugar cane and sugar beet. Remarkably, none of the 81 crops were found to be sufficiently represented in gene banks, with fruits, forage crops, sugar crops, roots and vegetables being the least well represented.

Finally, the researchers identified geographic 'hotspots' for high priority CWR, in East Asia, western and southern Europe, the Mediterranean, Near East, South America and South East Asia. These sites represent important targets for both *ex situ* conservation (collecting for conservation in gene banks) and local conservation. In these areas, up to 43 groups of CWR — associated with 23 crops — could be collected in a single 25 km^2 area.

The researchers conclude that — despite recent efforts to conserve important crops — CWR are under-represented in gene banks and a systematic effort is needed to conserve CWR for future food security. They recommend first targeting CWR for rice, maize, sugarcane, cassava, potato, bananas, sorghum, millets, sweet potato, yams, groundnut, cowpea and pigeon pea by collecting and storing them in gene banks. However, the researchers also discuss *in situ* conservation as an important protection strategy, especially for CWRs that do not produce seeds or whose seeds cannot be stored. Gene banks are just one part of what must be a multi-faceted response to food security, comprising local conservation and changes to agriculture.

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